

Ecology Unit Objectives

Essential Question:

How can we better understand the nature of life on earth by studying the interrelationships among organisms, species, and the non-living environment?

Objectives:

By the conclusion of this unit, you should be able to:

Chapter 50: The Scope of Ecology

1. Define ecology and identify the two features of organisms that ecologists try to explain. Discuss examples of experiments that examine these features.
2. Distinguish between the abiotic and biotic components of the environment.
3. Describe the relationship between ecology and evolutionary biology.
4. Distinguish among organismal ecology, population ecology, community ecology, ecosystem ecology, and landscape ecology.
5. Define the precautionary principle and illustrate its usefulness with regard to the ecological issues facing society.

Factors Affecting Distributions of Organisms

6. Describe the flowchart of inquiry used to determine what limits the geographic distribution of a particular species.
7. Describe the problem of introduced species and the specific problems posed by the introduction of African bees and zebra mussels.
8. Explain the "tens rule."
9. Explain how habitat selection can limit the range of otherwise suitable habitats.
10. Describe and illustrate biotic and abiotic factors that affect the distribution of organisms.
11. Explain how climate affects the geographic distribution of organisms.
12. Define and illustrate the concept of a microclimate.
13. Explain how the retreat of North American glaciers 16,000 years ago influenced the distribution of trees.

Aquatic and Terrestrial Biomes

14. Distinguish among the various zones found in aquatic biomes.
15. Define and compare the many types of freshwater and marine biomes.
16. Describe the characteristics of the major terrestrial biomes: tropical forest, savanna, desert, chaparral, temperate grassland, temperate forest, taiga, and tundra.

The Spatial Scale of Distributions

17. Explain why the distribution of a species is often not easily accounted for.

Chapter 51: Introduction to Behavior and Behavioral Ecology

1. Define behavior.
2. Distinguish between proximate and ultimate questions about behavior.
3. Explain how genes and the environment contribute to behavior. Explain what is unique about innate behavior.
4. Define fixed action patterns and give examples in fish and humans.
5. Explain how mayflies are threatened by an inappropriate response to an environmental stimulus.
6. Describe the evolutionary basis for behavioral ecology. Explain why these adaptations may result in suboptimal behavior.
7. Explain why it is useful to use evolutionary principles as a guide to behavioral research.
8. Explain the optimal foraging theory and illustrate it with examples.

Learning

9. Explain how learning, maturation, and habituation influence behavior.
10. Define imprinting and explain the importance of the sensitive period. Illustrate these concepts using examples from bird song.
11. Distinguish between classical conditioning and operant conditioning.
12. Define play and describe several possible adaptive advantages of this behavior.

Animal Cognition

13. Describe the ultimate bases of learning.
14. Describe and illustrate with examples kinesis, taxis, landmarks, cognitive maps, and migration.
15. Explain the problems of defining and studying consciousness.

Social Behavior and Sociobiology

16. Define sociobiology and describe the development of this field of behavior.
17. Define agonistic behavior, dominance hierarchy, and territories; give examples of each.
18. Describe the typical circumstances associated with the defense of territories.
19. Describe the advantages of courtship.
20. Explain how parental investment influences the different mating behaviors of males and females.
21. Define and distinguish between monogamous and polygamous mating relationships and between polygyny and polyandry.
22. Describe how the certainty of paternity influences the development of mating systems.
23. Describe the various modes of communication.
24. Relate an animal's mode of communication to its lifestyle.
25. Explain how honeybees communicate information about the location of sources of food.
26. Discuss why altruistic behavior might evolve.

27. Relate the coefficient of relatedness to the concept of altruism.
28. Define Hamilton's rule and the concept of kin selection.
29. Define reciprocal altruism.
30. Describe the premise of sociobiology.

Chapter 52: Characteristics of Populations

1. Define the scope of population ecology
2. Define and distinguish between density and dispersion.
3. Explain how ecologists measure the density of a species.
4. Describe conditions that may result in the clumped dispersion, uniform dispersion, and random dispersion of populations.
5. Describe the characteristics of populations that exhibit Type I, Type II, and Type III survivorship curves.

Life History Traits

7. Define and distinguish between semelparity and iteroparity.
8. Explain how limited resources affect life histories.
9. Give examples of the trade-off between reproduction and survival.

Population Growth

10. Compare the geometric model of population growth with the logistic model.
11. Explain how an environment's carrying capacity affects the intrinsic rate of increase of a population.
12. Distinguish between r -selected populations and K -selected populations.
13. Explain how a "stressful" environment may alter the standard r -selection and K -selection characteristics.

Population-Limiting Factors

14. Explain how density-dependent factors affect population growth.
15. Explain how density-dependent and density-independent factors may work together to control a population's growth.
16. Explain how predation can affect life history through natural selection.
17. Describe several boom-and-bust population cycles, noting possible causes and consequences of the fluctuations.

Human Population Growth

18. Describe the history of human population growth.
19. Define the demographic transition.
20. Compare the age structures of Italy, Kenya, and the United States. Describe the possible consequences for each country.
21. Describe the problems associated with estimating Earth's carrying capacity.

Chapter 53: What Is a Community?

1. Explain the relationship between species richness and relative abundance.
2. Define and compare the individualistic hypothesis of H.A. Gleason and the interactive hypothesis of F.E. Clements with respect to communities.

Interspecific Interactions and Community Structure

3. List four possible specific interactions and explain how the relationships affect the population densities of the two species.
4. Explain how interspecific competition may affect community structure.
5. Describe the competitive exclusion principle and explain how competitive exclusion may affect community structure.
6. Define an ecological niche and restate the competitive exclusion principle using the niche concept.
7. Explain how resource partitioning can affect species diversity.
8. Define and compare predation, herbivory, and parasitism.
9. Relate some specific predatory adaptations to the properties of the prey.
10. Describe the defense mechanisms that evolved in plants to reduce predation by herbivores.
11. Explain how cryptic coloration and warning coloration aid an animal in avoiding predators.
12. Distinguish between Batesian mimicry and Müllerian mimicry.
13. Describe how predators use mimicry to obtain prey.
14. Distinguish among endoparasites, ectoparasites, and pathogens.
15. Distinguish among parasitism, mutualism, and commensalism.
16. Distinguish between a food chain and a food web. Describe the factors that transform food chains into food webs.
17. Describe two ways to simplify food webs.
18. Summarize two hypotheses that explain why food chains are relatively short.
19. Explain how dominant and keystone species exert strong control on community structure. Give several examples of each.
20. Describe and distinguish between the bottom-up and top-down models of community organization. Also describe some models that are intermediate between those two extremes.

Disturbance and Community Structure

21. Describe how disturbances affect community structure and composition. Illustrate this point with several well-studied examples.
22. Give examples of humans as widespread agents of disturbance.
23. Describe and distinguish between primary and secondary succession.
24. Describe and distinguish among facilitation, inhibition, and toleration.
25. Describe the process and pattern of succession on moraines in Glacier Bay.

Biogeographic Factors Affecting the Biodiversity of Communities

26. Describe and distinguish between species richness and relative abundance.
27. Describe the data necessary to measure biodiversity.
28. Describe and explain how species richness varies along the equatorial-polar gradient.
29. Define the species-area curve.
30. Explain how species richness on islands varies according to island size and distance from the mainland.

Chapter 54: What Is the Ecosystem Approach to Ecology?

1. Describe the relationship between autotrophs and heterotrophs in an ecosystem.
2. Explain how decomposition connects all trophic levels in an ecosystem.
3. Explain how the first and second laws of thermodynamics apply to ecosystems.

Primary Production in Ecosystems

4. Explain why the amount of energy used in photosynthesis is so much less than the amount of solar energy that reaches Earth.
5. Define and compare gross primary production and net primary production.
6. Define and compare biomass and standing crop.
7. Compare primary productivity in marine, freshwater, and terrestrial ecosystems.

Secondary Production in Ecosystems

8. Explain why energy is said to flow rather than cycle within ecosystems. Use the example of insect caterpillars to illustrate energy flow.
9. Define, compare, and illustrate the concepts of production efficiency and trophic efficiency.
10. Distinguish between energy pyramids and biomass pyramids. Explain why both relationships are in the form of pyramids. Explain the special circumstances of inverted biomass pyramids.
11. Explain why food pyramids usually have only four or five trophic levels
12. Define the pyramid of numbers.
13. Explain why worldwide agriculture could feed more people if all humans consumed only plant material.
14. Explain the green-world hypothesis. Describe six factors that keep herbivores in check.

The Cycling of Chemical Elements in Ecosystems

15. Describe the four nutrient reservoirs and the processes that transfer the elements between reservoirs.
16. Explain why it is difficult to trace elements through biogeochemical cycles.
17. Describe the hydrologic water cycle.
18. Describe the nitrogen cycle and explain the importance of nitrogen fixation to all living organisms.
19. Describe the phosphorus cycle and explain how phosphorus is recycled locally in most ecosystems.
20. Explain how decomposition affects the rate of nutrient cycling in ecosystems.

Human Impact on the Chemical Dynamics of the Biosphere

22. Describe how agricultural practices can interfere with nitrogen cycling.
23. Explain how "cultural eutrophication" can alter freshwater ecosystems.
24. Describe the causes and consequences of acid precipitation.
25. Explain why toxic compounds usually have the greatest effect on top-level carnivores.
26. Describe how increased atmospheric concentrations of carbon dioxide could affect Earth.
27. Describe how human interference might alter the biosphere.

Chapter 55: The Biodiversity Crisis

1. Describe the three levels of biodiversity.
2. Explain why biodiversity at all levels is vital to human welfare.
3. List the four major threats to biodiversity and give an example of each.

Conservation at the Population and Species Levels

4. Define and compare the small-population approach and the declining-population approach.
5. Describe the basic steps that are common in the declining-population approach. Describe the case of the declining red-cockaded woodpecker to illustrate this approach.
6. Describe the conflicting demands that accompany species conservation.

Conservation at the Community, Ecosystem, and Landscape Levels

7. Explain how edges and corridors can strongly influence landscape biodiversity.
8. Define biodiversity hot spots and explain why they are important.
9. Explain why natural reserves must be functional parts of landscapes.
10. Define zoned reserves and explain why they are important.
11. Define restoration ecology and describe its goals. Explain the importance of bioremediation and the augmentation of ecosystem processes in restoration efforts.
12. Describe the process of adaptive management.
13. Describe the concept of sustainable development.
14. Explain the goals of the Sustainable Biosphere Initiative.
15. Define biophilia and explain why the concept gives some biologists hope.

KEY TERMS

Chapter 50

abiotic components
abyssal zone
aphotic zone
benthic zone
benthos
biogeography
biome
biosphere
biotic components
canopy
climate
community ecology
community
coral reefs
deep-sea hydrothermal vents
detritus
dispersal
ecosystem ecology
estuary
eutrophic
intertidal zone
landscape ecology
landscape
limnetic zone
littoral zone
mesotrophic
microclimate
neritic zone
oceanic pelagic biome
oceanic zone
oligotrophic lake
organismal ecology
pelagic zone
permafrost
photic zone
population ecology
population
precautionary principle
profundal zone
seascape
thermocline
tropics
turnover
wetland

Chapter 51

agonistic behavior
altruism
associative learning
behavior
behavioral ecology
classical conditioning

coefficient of relatedness
cognition
cognitive ethology
cognitive map
courtship
dominance hierarchy
ethology
fixed action pattern (FAP)
foraging
habituation
Hamilton's rule
imprinting
inclusive fitness
kin selection
kinesis
landmark
learning
monogamous
operant conditioning
optimal foraging theory
parental investment
pheromone
play
polyandry
polygamous
polygyny
promiscuous
reciprocal altruism
reconciliation
behavior
ritual
sensitive period
sign stimulus
signal
social behavior
sociobiology
taxis
territory

Chapter 52

big-bang
reproduction
carrying capacity
clumped
cohort
demographic transition
demography
density dependent
density-independent factor

density
dispersion
ecological footprint
geometric population growth
intrinsic rate of increase
iteroparity
K-selection
life history
life table
logistic population growth
mark-recapture method
negative feedback
population
r-selection
random
repeated reproduction
reproductive table
semelparity
survivorship curve
uniform
zero population growth

Chapter 53

Batesian mimicry
bottom-up model
commensalism
community
competitive exclusion
principle
cryptic coloration
disturbance
dominant species
ecological niche
ecological succession
ectoparasites
endoparasites
energetic hypothesis
facilitate
food chain
herbivory
heterogeneity
individualistic
hypothesis
inhibit
interactive hypothesis
interspecific competition
keystone species
Müllerian mimicry

mutualism
nonequilibrium model
parasitism
predation
primary succession
redundancy model
relative abundance
resource partitioning
rivet model
secondary succession
species richness
species-area curve
stability
tolerate
Top-Down Model
trophic level
trophic structure

Chapter 54

acid precipitation
autotrophs
biogeochemical cycles
biological magnification
biomass
detritus
ecosystem
greenhouse effect
gross primary production (GPP)
heterotrophs
net primary production (NPP)
nitrogen fixation
primary production
trophic level

Chapter 55

biodiversity crisis
biodiversity hotspot
conservation biology
landscape ecology
minimum viable
population size (MVP)
movement corridor
population viability analysis (PVA)
zoned reserve